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TECHNOLOGICAL ADVANCES AND IMPACTS ON PROFITABILITY AND INPUT USE EFFICIENCY IN MARINE FISHING: A COMPARATIVE ANALYSIS OF INDIGENOUS VS HIGH SPEED TRAWLERS IN KERALA STATE

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Abstract

The mechanized trawlers are the prominent fishing units in the marine fishing sector of Kerala state which contribute nearly 40% of the annual landings. The trawl fishing sector of the state witnessed several structural changes with introduction of multiday fishing and increase in capacities of engine and gears. The introduction of high speed engines in the mechanized trawl fishing sector of Kerala in 2007, replacing the indigenous engines was a major technological change occurred in the past decade. The high speed engines had a towing speed of 2.5-4.5 nm/hour. The increased fishing power of mechanized trawlers will have implications on the sustainable harvest of the resource as well as fisheries economy. The paper presents a comparative analysis of the economic efficiency of trawlers with high speed engine and indigenous engines based on data collected from the multiday trawlers operating in Ernakulam district, Kerala. The results indicated that the trawlers with high speed engines generated higher catch and return for the fishers compared to indigenous trawlers. However, the lower operational efficiency in terms of low capital productivity and fuel efficiency underscores the need for shifting to fuel efficient fishing techniques.

Key words*: Fuel efficiency, High speed trawlers, Profitability, Technological advance*

Introduction

The state of Kerala in the South west coast of India is an important maritime state contributing 16% of the marine fish landings in the country. The annual marine fish catch in the state was stagnant at around 6 lakh tonnes and there was a drastic reduction in marine fish catch in the recent years. Over exploitation, climate change and associated extreme events and environmental factors were reported to cause the fluctuations in marine fish landings in the state (CMFRI, 2018, Pratibha *et al.*, 2019). Trawlers are the prominent fishing units in the mechanized fishing sector of the state contributing 40% of the landings. Trawling on a commercial scale was first initiated in India at Sakthikulangara in Kerala through the Indo- Norwegian project in the 60s and later spread to other parts of the country. Eventhough the number of trawlers operated in the state declined from 3982 in 2005 to 3678 in 2010, there was increase in fishing power in terms of expansion in engine and gear capacities and overall length (OAL) of boats which facilitated multiday fishing trips and diversification of species caught.

Multiday trawling was initiated in Kerala in the late 90s. The fishing vessels which were undertaking singleday fishing trips started multiday fishing with increase in OAL of vessel up to 60' and horsepower up to 180 hp (Aswathy *et al.*, 2017). With the reduction in the catches of shrimps and cephalopods targeted by trawlers, high speed engines with horse power up to 250 hp were introduced from China which started operating in Ernakulam District from 2007 onwards replacing the indigenous engines. The horsepower of the engines were subsequently increased every year to improve the fishing capacity. Several controversies also followed with introduction of high speed engines and the subsequent increase in fishing capacity. The non-mechanized fisherfolk as well as a section of mechanized category fishermen were against the use of high speed engines pointing its low economic efficiency and impacts on sustainability of resources. Ernakulum district contributed 26% of the total landings in the state in 2017 and trawlers alone contributed 16% of the overall marine fish landings (FRAD, CMFRI, 2018). Since Ernakulam district contributes a significant share of trawl landings in the state and the high speed trawlers were primarily introduced in this district, a study was conducted in Ernakulam district to assess the impact of high speed trawlers on the profitability and input use efficiency compared to the indigenous trawlers.

Review of related work

Several authors studied the profitability of trawl fishery in different parts of the world. Geetha *et al.* (2014) in Chennai(Tamil Nadu); Narayanakumar (2012; Aswathy *et al.* in Kerala(2011) and Karnataka (2017) etc. However the economic performance of high speed trawlers were not covered in the previous studies. Micro level studies dealing with profitability and resource use efficiency have more relevance in developing regional or national level policies for fisheries management, provisions for investment or incentives to fisheries sector.

Materials and methods

Ernakulam district is an important maritime district in Kerala state and the mechanized trawlers alone contributed 16% of the total marine fish landings of the state. The two main fishing harbours in the district, Cochin and Munambam fisheries harbors where predominantly the multiday trawlers operated were selected for the study. More than 90% of the trawlers in Munmabam fishing harbor operated with high speed trawlers whereas indigenous trawlers dominated in Cochin fisheries harbor. Data were collected from 60 fishing boats each from Cochin and Munambam fishing harbours during the year 2017. Data on operational cost components , capital investment on hull, gear, engines and accessories as well as quantities prices of different species of fishes, engine details, modifications/ replacements done for the introduced engines, and operating expenses and revenues etc. were collected from the sampled boat operators.

The economic performance was assessed using the following conventional economic and financial performance indicators.

Gross revenue per trip (GR) = Σ Landings of resource (Q_i) x Price /kg of resource (P_i)

Gross profit (GP) = Gross revenue less direct fishing costs, indicating the short-term viability of the fisheries operation (FAO, 2015). The fishing costs consisted of costs of fuel, ice, labour, auction charges, water charges, landing charges and other miscellaneous expenses. The labour costs consisted of crew share and crew bata. The crew share was calculated as 35% of the gross profit after deducting all operational cost expenses from gross revenue.

Net profit= GP- (Depreciation + Interest on fixed capital)

Input-Output Ratio= Input cost/ Gross revenue

Operating ratio= Operating costs/ Gross revenue

Operating ratio measures the operational efficiency of a firm or enterprise

Net benefit earnings ratio = Net Cash Flow (NCF)/Total Earnings (TE)

The ratio expresses the NCF or net benefit as a percentage of TE. A ratio of more than 10% can be considered as good

Return on investment (ROI) = Net profit/Capital investment

The NCF or net profit expressed as a percentage of the invested capital indicates the profitability of the investment in relation to

other alternative investments. A level of 10 percent is generally considered to be a good.

Fuel use intensity=Fuel (Litres)/ Fish production (tonnes)

Results and Discussion

The trawlers are the prominent fishing units in Ernakulam district. The indigenous trawlers were fitted with Ashok Leyland or Tata engines of capacities 160-200 hp. The high speed trawlers are fitted with high speed engines imported mainly from China, US and Japan. All the sampled trawlers in Munambam harbor operated with high speed engines imported from China. The popular brands were Shanghai, Weichai, Euchai, and Sinotruk. The horsepower of the engines ranged from 280-495 hp. The average no of fishing days per trip was 7 days for indigenous engine and 9 days for high speed engine. Higher catch, high cruise speed and species diversification were the major reasons for conversion into Chinese engines. Chinese engines also enabled the use of large nets and easy movement at sea. The high speed engines were capable of trawling the sea from the bottom to the surface, at a speed of 2.5 to 4.5 nautical miles, while other boats trawl the bottom at a speed of less than 2.5 nautical miles. The average diesel consumption per trip was 1018 litres for indigenous trawlers and 3904 litres for trawlers with high speed engines (Table 1).

Costs and revenues in trawl fishing operations

The capital investment was calculated based on present value of the boats at the time of sampling. The capital investment increased very much with introduction of high speed engines. The average cost of an indigenous engine was ₹4.12 lakhs and ₹13.16 lakhs for high speed engine. The annual fixed cost was calculated based on depreciation and interest on fixed capital. (Table 2).

The operational costs and revenues were calculated based on the costs and returns per fishing trip. Analysis of operational costs and revenues of trawlers indicated that the total operating cost was ₹1.85 lakhs for indigenous trawlers and ₹4.39 lakhs for high speed trawlers. The crew wage accounted 46.4% of the total cost in the case of indigenous trawlers whereas 51.53% of the total cost was incurred as fuel cost in the case of high speed trawlers. Narayanakumar (2012) also reported that fuel and labour cost accounted 54 and 25% respectively of the total operating cost of mechanized singleday trawlers in Andhra Pradesh(Narayanakumar, 2012). The crew wages were paid as share of the gross profit and hence a rise in fuel cost will reduce the labour earnings. FAO (2015) also reported that at higher technology and capitalization, the rising fuel cost will reduce the labour costs in fishing sector.

The annual fixed cost was calculated based on the depreciation and interest on craft, gears, engine and accessories. The fixed cost per trip was calculated based the no of trips undertaken by the fishing units. On an average, the high speed trawlers undertook 30 trips per annum and 40 trips per annum by the indigenous trawlers. The fixed cost accounted 11.71% of the total cost for indigenous trawlers and 9.69% for high speed trawlers (Table 3).

The economic and financial performance indicators implied that both multiday trawlers operating with indigenous engines and high speed engines were profitable. The high speed trawlers received higher catch and revenue when compared to indigenous trawlers. The indigenous trawlers received a net profit of 63,098 whereas the high speed trawlers received a net profit 1.29 lakhs per fishing trip. The return on investment was higher for high speed trawlers (75%) compared to indigenous trawlers. The net benefit-earnings ratio was higher for indigenous trawlers compared to high speed trawlers. Both indigenous and high speed trawlers had lower operational efficiency with operating ratio more than 0.5(Table 4).

The fuel use intensity was 632 litres/ tonne of fish for the indigenous trawlers when compared to 1389 litres for high speed trawlers. The fuel cost as percentage of gross earnings was 24% in the case of indigenous trawlers and 41% in the case of high speed trawlers which was higher than the global average figures for marine fishing vessels. The global average fuel cost as percentage of gross earnings was 21.63% in developing countries and 10.06% in developed countries (FAO, 2015).

The high input-output ratio and low fuel efficiency in the high speed trawler sector implies overuse of inputs in the sector. The low fuel efficiency indicates high CO_2 emissions and the necessity to regulate the capacity of high speed trawl sector to achieve optimum fuel efficiency. Several studies in the past also pointed out the need for optimizing and regulating capacities of the fishing vessels in the state in order to mitigate negative impacts on resources, conserve fuel and reduce greenhouse gas (GHG) emissions, (Baiju *et al*., 2012; Mohamed *et al.*, 2013, Renju Ravi *et al*, 2014).

Conclusion and policy implications

The analysis indicated that the trawlers operating with high speed engines and indigenous trawlers were showing good economic performance. The trawlers with high speed engines realized more catch and net profits and return on investment, however the high input –output ratio and low fuel efficiency indicated increased input costs in the sector. Trawlers being the prominent fishing units in the state, conversion of more and more trawlers to high speed engines, will raise the overall fishing costs which will have serious implications on the marine fish economy of the state. The increased fuel use in the trawl fishing sector is a key issue of concern in the context of climate change and it is imperative to regulate the capacity of high speed trawlers to optimize resource use efficiency and promotion of fuel efficient technologies in the marine fishing sector.

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Table 1. General particulars of trawlers with Indigenous and high speed engines

Sl. No.	Items of cost	Indigenous engine	High speed engine
1.	Engine HP	160-200	280-495
2.	Days of fishing	7	9
3.	Towing speed	<2.5Nm	2.5-4.5Nm
4.	Fuel consumption/ trip	1018	3904
5.	Catch (kg)	1628	2810

Table 2.Capital investment in trawlers (₹)

Particulars	Indigenous	High speed Chinese
Price of Hull	3133334	3983333
Engine	412500	1316667
Net	246667	333334
Accessories	1366666	1584167
Total	5159167	7217501

Table 3.Costs of fishing operations per trip (₹/trip)

Particulars	Indigenous	% share	High speed	% share
Crew Wage	97246	46.38	108919	22.38
Fuel Cost	65387	31.18	250739	51.53
Auction charges	9331	4.45	35369	7.27
Crew Bata	9903	4.72	15701	3.23
Other expenditure	3267	1.56	28716	5.90
Total operating costs	185134	88.29	439443	90.31
Fixed cost	24550	11.71	47170	9.69
Total cost	209684	100.00	486613	100.00

Table 4. Economic indicators per fishing trip

Particulars	Multiday Trawlers	
	Indigenous engine	High speed engine
Gross revenue (₹)	272782	616335
Gross profit(₹)	87648	176892
Net profit(₹)	63098	129722
Return on investment (%)	35.0	75.4
Net benefit earnings ratio	0.23	0.21
Capital productivity ratio	0.68	0.71
Input-output ratio	0.29	0.51
Fuel cost as % of gross revenue	24	41
Fuel use intensity(litres)	632	1389